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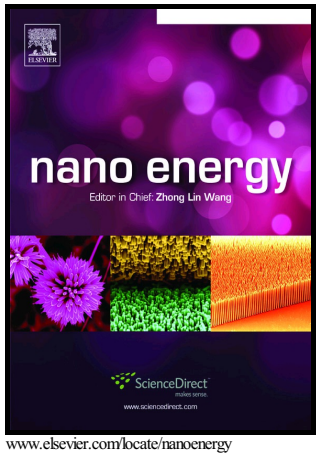

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Low temperature processed high-performance thick film ternary polymer solar cell with enhanced stability

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Abstract

Recently, efficient thick-film polymer solar cells (PSCs) were reported to be promising candidates for large-area module device fabrication because of their potential compatibility with roll to roll processing technique. Nevertheless, most of thick-film PSCs with high power conversion efficiencies (PCEs) were fabricated under high temperature (over 100 °C, namely "Hot-Processing"), which restricts their potential commercialization application. Herein, a new pathway was developed to make high performance thick-film PSCs under a mild condition without hot-processing. It was found that the ternary strategy can efficiently tune the processing conditions of thick film PSCs due to the decrease of polymer aggregation intensity. Consequently, high-efficiency thick-film ternary PSCs (10.59%) without hot-processing are designed and fabricated by introducing the nematic liquid-crystalline small molecule (benzodithiophene terthiophene rhodanine, BTR) into fluorinated benzothiadiazole-based polymer (P*ff*BT4T-2OD):fullerene host blend. The morphology studies reveal that the incorporation of BTR has a similar effect as hot-processing on the blend films, resulting in a much improved nano-scale phase separation. It was also demonstrated that the addition of BTR is beneficial for improving light harvesting, charge separation, transport and extraction of the resulting devices. Moreover, this ternary strategy shows a well general applicability for other systems that need hot-processing. Such as for naphthobisthiadiazole-based polymer PNTT, the optimized ternary device without hot-processing obtained an improved performance with a PCE of 11.44%, which is one of the highest-efficiency thick-film PSCs reported to date. Therefore, our results provide a facile approach to fabricate the high performance PSCs with thick-active layer at a lower temperature instead of hot-processing and may meet the needs of future roll-to-roll production of PSCs.

Keywords: Polymer solar cells; Ternary thick active layer; Low temperature processing; Long-term stability; Power conversion efficiency

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